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Potential host range of *Spilosoma dalbergiae* (Moore) n. ssp. (Lepidoptera: Arctiidae) in India

S. N. Tiwari* and N. P. Kashyap

Department of Entomology — Apiculture, Himachal Pradesh Agricultural University, \cdot Palampur-176062 INDIA

Abstract. The potential host range of *Spilosoma dalbergiae* (Moore) n. ssp. was determined by measuring feeding damage to pieces cut from leaves of 67 plant species and varieties, and was compared with literature reports of host range of other *Spilosoma* species. These tests indicated that *dalbergiae* is polyphagous, and has both horticultural and agricultural pest potentialities.

Introduction

A number of species of Spilosoma are engaged in the defoliation of a large variety of plant species of economic importance in North American, Afro-Asian, and European countries. In the oriental region, S. obliqua has been reported to cause serious damage to many crops (Patel, 1944, Anonymous, 1969; Prasad and Premchand, 1980). The taxa Spilosoma dalbergiae, S. todara and S. bifascia have been regarded as synonyms of obliqua (Lall, 1964). There are now reasons to believe that obliqua and dalbergiae are separate species (W. Thomas, personal communication), and in some instances damage attributed to obliqua might have been caused by dalbergiae.

The feeding behavior of larvae of *S. dalbergiae* n. ssp. is similar to *obliqua*. During early instars (I and II) larvae of *dalbergiae* n. ssp. feed gregariously on the leaf surface and do not move from plant to plant. In their advanced instars they move from plant to plant and from field to field, feeding on many plant species. The larvae may not restrict themselves to a particular habitat in later instars. The damage is done mainly by 3rd to 7th instar larvae, which skeletonize the plant.

There are several records of plants susceptibilities to *S. obliqua*, but most are based on observations of feeding damage. Bhattacharya and Rathore (1977) have published the host list of *S. obliqua* which contains 94 actual or potential hosts. However, host lists based on visual signs of damage provide no data concerning the influence of host plants

^{*} Present address: Department of Entomology, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar-263145, INDIA.

on the feeding behavior of insect (Ladd, 1987). Many researchers have carried out feeding tests to obtain information on these aspects (Kogan and Goeden, 1970; Bhattacharya and Rathore, 1977).

The information on the host range of species can be utilized in the planning of the ecosystem for the establishment of an insect pest management programme. In the majority of ecosystems, agricultural and horticultural crops are surrounded by large tracts of uncultivated land. These areas harbor many plants which constitute a vital part of ecological niche of both pests and beneficial insects. In addition to providing protected sites during adverse conditions, such areas provide food to the insects when the fields are crop-free (Price and Waldbauer, 1982).

The purpose of this study was to determine the range of potential hosts of S. *dalbergiae* n. ssp. so that feeding behavior and pest potentiality could be quantified and susceptibility of ecosystem to it determined.

Materials and Methods

Taxonomy: The adults of S. dalbergiae and S. obliqua have been described by Hampson (1894) and Ahmad and Ahmad (1976) respectively. A complete description of the adults of this new subspecies will be published by Dr. W. Thomas (West Germany). Nominate S. dalbergiae is distributed in Kangra, Sikhim, Kasis and Nagas (Hampson, 1894), this new subspecies has been observed in Kangra and Pantnagar. *We provide here enough information to distinguish the immature stages of the two species.

The egg clusters of *dalbergiae* n. ssp. are not as compact as those of *obliqua*. The newly-hatched larvae of *dalbergiae* n. ssp. are yellowish, and the body is covered with tiny hair. A pink ring on the first abdominal segment, and pink spots on the last three segments, appear on the 2nd day. A dark black band on the first abdominal segment is apparent in the 2nd and 3rd instars, on a ground color of filthy yellow. The 4th, 5th and 6th instars are a dark and dirty yellow and possess a black band on the 1st abdominal segment. The dorsal part of the posterior segment is also black. The color of the 7th instar becomes dark and rusty.

In case of S. obliqua, the color of 1st instar is pale yellow and there are no pink bands or spots on the body. The second instar larva becomes yellowish with a greenish tinge, and there is no black band on the 1st abdominal segment. The color further darkens through the fourth instar. The thoracic segments and the three posterior abdominal segments develop a blackish tinge in the 5th instar, which remains until the last instar (Goel and Arun Kumar, 1983). The black band on the 1st abdominal segment of S. dalbergiae is not found in S. obliqua at any stage.

Culture: Adults were collected in a light trap. Paired insects were held for egg laying in plastic jars (diameter 9 cm; height 10.5 cm), the walls of which were lined with white paper. Adults were provided with a 10 percent sucrose solution soaked in cotton as food. The eggs obtained were kept in petridishes for hatching, and newly emerged larvae were reared under laboratory conditions (temperature: mean T min = 17.3°C; mean T max = 26.3°C; relative-humidity: mean RH min = 58.1% mean RH max = 93.7%) in glass jars (22 × 30 cm). The larvae were reared to fourth or fifth instar on the leaves of cowpea (*Vigna unguiculata* (L.) Walp.), which is known to be a good medium for rearing S. obliqua.

Host range test: The experiment was conducted in glass petridishes (12.25 cm diameter), the bottoms of which were filled with a 1 cm thick layer of wax. The surface of the wax was covered with blotting paper. Sixty seven cultivated or wild plant species were selected from various habitats (forest, horticultural, and agro-ecosystem) in Palampur (Himachal Pradesh). Each host was tested simultaneously in two petridishes. Four 1 cm square pieces were cut from the leaves of test plants and were fixed equidistant in the perimeter of each petridish with micro-entomological pins, 3 to 4 mm above the surface of blotting paper, so that larvae could feed freely on them. Before experimentation, the larvae were starved for 20 hours. One larva was released in the center of each petridish and was allowed to feed for two hours. The area of each leaf piece eaten by the larva was estimated using graph paper. Percent feeding on each plant species was calculated by taking the average of the 8 leaf pieces.

Results and Discussion

Feeding varied from 0 to 100 per cent among plant species (Table 1). In our opinion, the plants on which feeding was less than 5 per cent should not be included in the host spectrum of the species, since such low feeding rates may result from test bites by the insect, which may be taken even on non-host plants. So, the plants D. gyrans, C. cajan, M. charantia, M. cochinchinensis, Z. mays, S. vulgare, L. esculentum, O. sativa, S. officinarum, P. purpureum, C. sinensis, J. regia, C. rotundus, C. nobilis x C. deliciosa, L. chinensis, Musa sp., C. medica v. galgal, E. japonica, O. europaea, M. indica, R. religiosa, and E. globulus should not be included in the host list of S. dalbergiae.

Significant differences were noticed in the degree of feeding on different varieties of G. max; Punjab-1 was eaten more as compared to Bragg and Lee. Other Leguminous crops (i.e., D. biflorus, P. sativum, P. vulgaris, P. mungo and V. unguiculata) did not show any difference in percent feeding. Among Cucurbitaceous vegetables, L. cylindrica and C. sativus were eaten appreciably. As compared to other Solana-

GROUP-1. AGRICULTURAL CROPS GROUP-2. HORTICULTURAL AND FOREST PLANTS GROUP-1. AGRICULTURAL CROPS Undis schematical Mours stativa 100 Utifis cylindrica Undis schematical 87.56±12.33 Mours stativa 100 Undis cylindrica Countribiaesee 73.50±12.13 Prunus persica Reseablinicidae 73 Dolichos billorus Leguminosase 61.25±11.13 Prunus persica Reseablance 75 Prunus partica Countributaceae 43.50±1.13 Prunus persica Reseablanceae 75 Phaseolis vulgaris Leguminosae 43.50±1.13 Prunus persica Reseablanceae 75 Phaseolis vulgaris Leguminosae 43.50±1.13 Prunus persica Reseablanceae 77 Phaseolis vulgaris Leguminosae 43.50±1.13 Amontan ubulatum Eleguminosae 55 Praseolis vulgaris Leguminosae 25.51±1.23 Amontan ubulatum Eleguminosae 55 Praseolis vulgaris Leguminosae 23.61±1.21 Robinia peudoacai 80 77 Praseolis vulgaris	Test Plant	Family	Percent feeding	Test Plant	Family	Percent feeding
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LusMalvaceae23.88±5.39Prunus domesticaLeguminosae23.13±0.63Punica granatumAraceae23.13±0.63Populus sp.Leguminosae20.63±20.69Populus sp.Cruciferae20.65±0.63Cannabis sativaLeguminosae17.25±0.63Carva illinoensisLeguminosae17.25±0.63Carva illinoensisLeguminosae17.25±0.63Carva illinoensisSolanaceae9.38±9.40Citrus limonSolanaceae9.38±9.40Citrus limonSolanaceae9.38±0.110.01Leguminosae9.38±0.13C. nobilis x C. deliciosaSolanaceae2.0130.011.00Leguminosae2.88±0.13C. nobilis x C. deliciosaSolanaceae0.012±0.13C. nobilis x C. deliciosaLeguminosae0.012±0.13C. nobilis x C. deliciosaSolanaceae0.002±0.00C. medica v. galgalGraminae0.000±0.000.00Cyperaceae0.000±0.00Combinae0.000±0.00Graminae0.000±0.00Combinae0.000±0.00Curreitoria0.000±0.00Curreitoria0.000±0.00Curreitoria0.000±0.00Curreitoria0.000±0.00Curreitoria0.000±0.00Curreitoria0.000±0.00Curreitoria0.000±	Ricinus communis	Euphorbiaceae		Lagerstroemia indica	Melastomaceae	38.00± 9.03
Leguminosae23.13±0.63Punica granatumAraceae20.88±2.88Rosa indicaAraceae20.63±20.69Populus sp.Cruciferae20.63±20.63Cannabis sativaLeguminosae17.55±6.27Grewia sp.Leguminosae17.55±1.014.01Psidium guajavaSolanaceae9.38±9.40Citrus limonSolanaceae9.38±9.40Citrus limonSolanaceae9.38±9.40Citrus limonSolanaceae9.38±9.40Citrus limonSolanaceae9.38±9.40Citrus limonSolanaceae9.38±9.40Citrus limonSolanaceae9.38±0.13C. nobilis x C. deliciosaLeguminosae0.00±1.00Litchi chinensisSolanaceae0.012±0.00Litchi chinensisSolanaceae0.00±0.00C. medica v. galgalGraminae0.00±0.00Olea europaeaCyperaceae0.00±0.00Ficualyptus globulusMusae0.00±0.00Eucalyptus globulus	Abelmoschus esculentus	Malvaceae		Prunus domestica	Rosaceae	37.63±37.49
Araceae20.88± 2.88Rosa indicaLeguminosae20.63±20.69Populus sp.Cruciferae20.63±20.63Cannabis sativaLeguminosae17.25± 6.27Grewia sp.Leguminosae17.55± 1.50Carya illinoensisAmaaraceae9.38± 9.40Citrus limonSolanaceae9.38± 9.40Citrus limonSolanaceae9.38± 9.40Citrus limonSolanaceae9.38± 9.40Citrus limonSolanaceae9.38± 9.40Citrus limonSolanaceae3.00± 1.00Luglans regiaSolanaceae2.88± 0.13C. nobilis x C. deliciosaLeguminosae0.12± 0.13Musa sp.Cucurbitaceae0.12± 0.13Musa sp.Graminae0.00± 0.00C. medica v. galgalGraminae0.00± 0.00Mangifera indicaCyperaceae0.00± 0.00Ficuohyptus globulusmGraminae0.00± 0.00framinae0.00± 0.00Ficuohyptus globulus	Vigna unguiculata	Leguminosae		Punica granatum	Myrtaceae	36.13± 1.13
Leguminosae20.63±20.63Populus sp.Cruciferae20.62± 0.63Cannabis sativaCruciferae20.62± 0.63Cannabis sativaLeguminosae17.25± 6.27Grewia sp.Leguminosae17.55± 1.00Carya illinoensisAmaranthaceae9.40Cirus linonSolanaceae9.33± 9.40Cirus linonSolanaceae3.00± 1.00Juglans regiaSolanaceae2.88± 0.13C. nobilis x C. deliciosaSolanaceae2.88± 0.13C. nobilis x C. deliciosaLeguminosae0.01± 0.00Litchi chinensisSolanaceae0.00± 0.00C. medica v. galgalGraminae0.00± 0.00Cirus linonciaCyperaceae0.00± 0.00Marsa sp.Graminae0.00± 0.00Friobotrya japonicaGraminae0.00± 0.00Fricos religiosanGraminae0.00± 0.00forminae0.00± 0.00Graminae0.00± 0.00forminae0.00± 0.00forminae0.00± 0.00forminae0.00± 0.00forminae0.00± 0.00	Colocasia esculenta	Araceae	20.88± 2.88	Rosa indica	Rosaceae	29.50±29.59
Cruciferae20.62±0.63Cannabis sativaLeguminosae17.25±6.27Grewia sp.Leguminosae17.25±6.27Grewia sp.Leguminosae13.50±13.04Carya illinoensisAmaranthaceae10.00±4.01Psidium guajavaSolanaceae3.03±1.50Lugians regiaSolanaceae3.00±1.00Lugians regiaSolanaceae2.88±0.13Camelifs xC. deliciosaSolanaceae2.88±0.13C. nobilis x C. deliciosaSolanaceae2.88±0.13Musa sp.Solanaceae0.00±0.00Camelifs xC. deliciosaSolanaceae0.012±0.13Musa sp.Solanaceae0.00±0.00C. medica v. galgalGraminae0.00±0.00Mangifera indicaCyperaceae0.00±0.00Ficus religiosamGraminae0.00±0.00Ficus religiosa	G. max (Lee)	Leguminosae	20.63±20.69	Populus sp.	Salicaceae	21.50 ± 21.56
Leguminosae 17.25 ± 6.27 Grewia sp.Leguminosae 13.50 ± 13.04 Carya illinoensisAmaranthaceae 13.50 ± 13.04 Carya illinoensisAmaranthaceae 9.38 ± 9.40 Citrus limonSolanaceae 9.30 ± 1.00 Juglans regiaSolanaceae 2.88 ± 0.13 C. nobilis x C. deliciosaLeguminosae 0.10 ± 1.00 Litchi chinensisCucurbitaceae 0.10 ± 1.00 Litchi chinensisLaguminosae 0.01 ± 0.00 C. medica v. galgalGraminae 0.00 ± 0.00 Olea europaeaCyperaceae 0.00 ± 0.00 Mangifera indicaMusGraminae 0.00 ± 0.00 Ficus religiosaMusGraminae 0.00 ± 0.00 Eucal/yptus globulusMus 0.00 ± 0.00 Eucal/yptus globulus	Raphanus sativus	Cruciferae	20.62± 0.63	Cannabis sativa	Moraceae	19.25±19.31
Leguminosae 13.50 ± 13.04 Carya illinoensisAmaranthaceae 10.00 ± 4.01 $Psidium guajava$ Amaranthaceae 9.38 ± 9.40 $Citrus limon$ Solanaceae 3.00 ± 1.00 $Juglans regia$ Solanaceae 2.88 ± 0.13 $C. nobilis x C. deliciosa$ Solanaceae 2.88 ± 0.13 $C. nobilis x C. deliciosa$ Solanaceae 0.01 ± 1.00 $Litchi chinensis$ Solanaceae 0.01 ± 0.00 $Litchi chinensis$ Solanaceae 0.00 ± 0.00 $C. medica v. galgalGraminae0.00\pm 0.00C. medica v. galgalCyperaceae0.00\pm 0.00Picus religiosaMusa sp0.00\pm 0.00Picus religiosa$	G. max (Bragg)	Leguminosae	17.25± 6.27	Grewia sp.	Tiliaceae	
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Graminae0.00±0.00C. medica v. galgalGraminae0.00±0.00Eriobotrya japonicaUlentumSolanaceae0.00±0.00Olea europaeaCyperaceae0.00±0.00Mangifera indicaGraminae0.00±0.00Ficus religiosaarumGraminae0.00±0.00Eucalyptus globulusIreumGraminae0.00±0.00±0.00	Mucuna cochinchinensis	Leguminosae		Musa sp.	Musaceae	
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Solanaceae 0.00± 0.00 <i>Olea europaea</i> Cyperaceae 0.00± 0.00 <i>Mangifera indica</i> Graminae 0.00± 0.00 <i>Ficus religiosa</i> Graminae 0.00± 0.00 <i>Eucalyptus globulus</i> Graminae 0.00± 0.00	Sorghum vulgare	Graminae		Eriobotrya japonica	Rosaceae	
Cyperaceae 0.00± 0.00 Mangifera indica Graminae 0.00± 0.00 Ficus religiosa Graminae 0.00± 0.00 Eucalyptus globulus Graminae 0.00± 0.00	Lycopersicum esculentum	Solanaceae		Olea europaea	Oleaceae	
Graminae 0.00± 0.00 <i>Ficus religiosa</i> Graminae 0.00± 0.00 <i>Eucalyptus globulus</i> Graminae 0.00± 0.00	Cyperus rotundus	Cyperaceae		Mangifera indica	Anacardlaceae	
Graminae 0.00± 0.00 <i>Eucalyptus globulus</i> Graminae 0.00± 0.00	Oryza sativa	Graminae		Ficus religiosa	Moraceae	
Graminae 0.00±	Saccharum officinarum	Graminae		Eucalyptus globulus	Myrtaceae	0.00± 0.00
	Pennisetum purpureum	Graminae				

108

Table 1: Host range of Spilosoma dalbergiae (Moore) n. ssp.

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ceous vegetables tested, S. melongena was eaten more. No significant difference was seen in feeding among Cruciferous vegetables.

Temperate fruits were consumed more as compared to sub-tropical fruits; however, no significant differences existed among different pome, stone, or nut fruits. Other temperate fruits like F. ananassa and P. granatum were also eaten appreciably while O. europaea was rejected. Percent feeding was very low on all the sub-tropical fruits tested. Appreciable feeding occured on some other plants of this group also. Maximum feeding occured on M. alba followed by B. variegata and L. camara.

Comparison of the host range of different species of Spilosoma indicates that various plant species such as A. esculentus, B. campestris var. sarson, C. cajan, C. sativa, C. sativus, D. biflorus, L. camara, L. cylindrica, P. mungo, S. oleracea and V. unguiculata are eaten by both the Oriental species, obliqua and dalbergiae. S. dalbergiae also has some hosts like C. pepo, P. vulgaris, P. domestica and P. persica common with the North American species S. virginica. G. max, P. sativum, R. sativus, R. communis, S. melongena, S. tuberosum, and B. oleracea var. capitata are hosts of S. dalbergiae, S. obliqua and S. virginica. M. alba has been found to be a host of many Spilosoma species, including dalbergiae, obliqua, imparilis, lubricipeda, mori and subcarnea (Maki, 1916; Fenton, 1937; Golanski, 1967; Tietz, 1972; Bhattacharya and Rathore, 1977; Roberts et al., 1977; Hondo, 1981).

S. dalbergiae and S. obliqua (Bhattacharya and Rathore, 1977) showed several similarities and differences in their host preference. Both these species rejected M. charantia, M. indica, F. religiosa, O. sativa and S. officinarum. S. dalbergiae ssp. n. accepted the plants P. granatum, S. tuberosum and F. carica, which are rejected by S. obliqua. This species rejected C. rotundus and Z. mays, which are accepted by S. obliqua. The plants C. sativus and S. oleracea were found to be good host plants for both species. Neither species preferred P. guajava.

The wide range of acceptable hosts clearly indicates that the new subspecies of *dalbergiae* is polyphagous. The tendency of the insect to feed on temperate fruits (e.g., almond, apple, pear, peach, plum, and strawberry), vegetables (e.g., pumpkin, vegetable sponge, cucumber, brinjal, potato, radish, cabbage, mustard, lady-fingre, and spinach), and legumes (e.g., pea, black gram, French bean and soybean) indicates that the species has both horticultural and agricultural pest potentialities. It also readily accepted many forest and ornamental plants. We cannot rule out the possibility that some of the out-breaks recorded for *obliqua* (Lall, 1964) might have been caused by *dalbergiae*. The tendency of *dalbergiae* to feed on a wide variety of plant species indicates that the insect can be a pest in many ecosystems.

The spectrum of potential host plants of early and advanced instars of larvae may vary. Generally, the spectrum of potential host plants have been found to be wider for early instars than for old larvae (Wiklund, 1973). The host range of this new subspecies indicates that it can survive well in agricultural, forest, or mixed systems. The ability of the species to feed on seasonal, annual, biennial, perennial, herbs, shrubs, or trees indicate its substantial potential as a pest species.

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28(1-2):1-136, 1989(90)

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